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ABSTRACT

As the terms "multidisciplinary" and "interdisciplinary" are frequently used in general systems literature without a clear determination of their meanings, the author seeks to show a logical and epistemological interpretation of their meanings in the context of an organismic model for curriculum design. Logical and epistemological categories of knowledge and knowing are utilized to illustrate the possibilities for multidisciplinary and interdisciplinary inquiry and to illustrate an organismic theory models approach to educational inquiry. This approach necessitates that the teaching-learning process be viewed as a structured whole, i.e., one in which the content and form of its parts are determined by its function, thus not having nonalterable natures and fixed actions or relations. (Author/MB)

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A SYSTEMS INTERPRETATION OF MULTIDISCIPLINARY AND INTERDISCIPLINARY INQUIRY IN CURRICULUM DESIGN

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ABSTRACT

As the terms 'multidisciplinary' and 'interdisciplinary' are frequently used in general systems literature without a clear determination of their meanings, I sought to show a logical and epistemological interpretation of their meanings in the context of an organismic model for curriculum design. Logical and epistemological categories of knowledge and knowing were utilized to illustrate the possibilities for multidisciplinary and interdisciplinary inquiry, and to illustrate an organismic theory models approach to educational inquiry. This approach necessitates that the teaching-learning process be viewed as a structured whole, i.e. one in which the content and form of its parts are determined by its function, thus not having non-alterable natures and fixed actions or relations.

The terms 'multidisciplinary' and 'interdisciplinary' are frequently used in general systems literature without a clear determination of their meanings, particularly relative to kinds of truth-functional, i.e. knowledge-producing inquiry. The significance of the meanings of these terms with respect to the organization of curriculum components of educational systems* has been only obliquely referred to in the systems literature focusing upon human teaching-learning systems. As an adequate determination of the meanings of these terms is of paramount importance to effect the educational function of multidisciplinary and interdisciplinary inquirers, I want to focus here on some of the contemporary problems implicit in and surrounding curriculum organization so as to propose an organismic systemic solution to these problems.

Questions regarding the nature of knowledge and knowing upon which determination of curriculum organization depends (or should depend), are epistemological questions. Thus epistemological theory should be a source for wanted principles significant to curriculum organization. According to a long academic tradition, knowledge has been grouped for pedagogical purposes in four major categories: the natural sciences, the social sciences, mathematics and humanities. These broad groupings have been taken to be basic cultural interests representing distinctive methods and conceptual schemes in which human experience and the universe are viewed (Bellack, 1964, p. 233). Epistemologically, the groupings are not adequate as categories of kinds of human knowledge and knowing, nor are they adequate to understand the logical relations and epistemological relations of multidisciplinary and interdisciplinary inquiry. Currently, many epistemologists group knowledge and knowing propositions

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*My focus of attention here will be primarily on curriculum organization in higher education, particularly the education of educators, though the major arguments apply to all teaching-learning systems.

according to logical criteria and evidential criteria. 'Propositions' are taken to be cognitive assertions which may be exhibited in a variety of ways generally categorized as follows: symbolic propositions (from ordinary language statements to highly precise formal language statements), ikonic propositions (from pictorial representations such as paintings to diagrammatic representations such as cybernetic schemas), enactive propositions (from fine performances such as ballet to mechanical performances such as programming a computer). These are depicted in schema 1. Categorized very broadly, knowledge and knowing exhibited by the various propositions may be illustrated as depicted in schema 2, including quantitative (theoretical) knowledge, qualitative (atheoretical) knowing, and performative (both quantitative and qualitative) knowing.

To clearly demonstrate the multidisciplinary and interdisciplinary nature of inquiry, the logical and epistemological distinctions between kinds of quantitative theoretical knowledge production as depicted in schema 2 will be focused upon. Obviously, theoretical knowledge is that knowledge exhibited in highly precise, formal language structures. Quantitative (theoretical)* knowledge consists of true generalizations and facts about states of affairs (Maccia, 1975, p. 23). These generalizations are true propositions asserting universal connections characterizing components and their interrelations and so constitute theoretical knowledge. Kinds of theoretical knowledge may be sorted epistemologically on the basis of the kind of generalization produced from the inquiry: whether the content of the generalization is normative or non-normative, empirical or non-empirical, and on the basis of the kind of norm described, i.e. whether the norm is that of effectiveness (instrumental good) or worthwhileness (intrinsic good). Kinds of theoretical knowledge may be

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*Throughout, I will utilize 'theoretical' to mean quantitative knowledge. I will also utilize 'atheoretical' to mean qualitative knowing, though I will primarily focus upon theoretical knowledge for the sake of brevity.

SYMBOLIC PROPOSITIONS

Natural language statements _____ Formal language statements

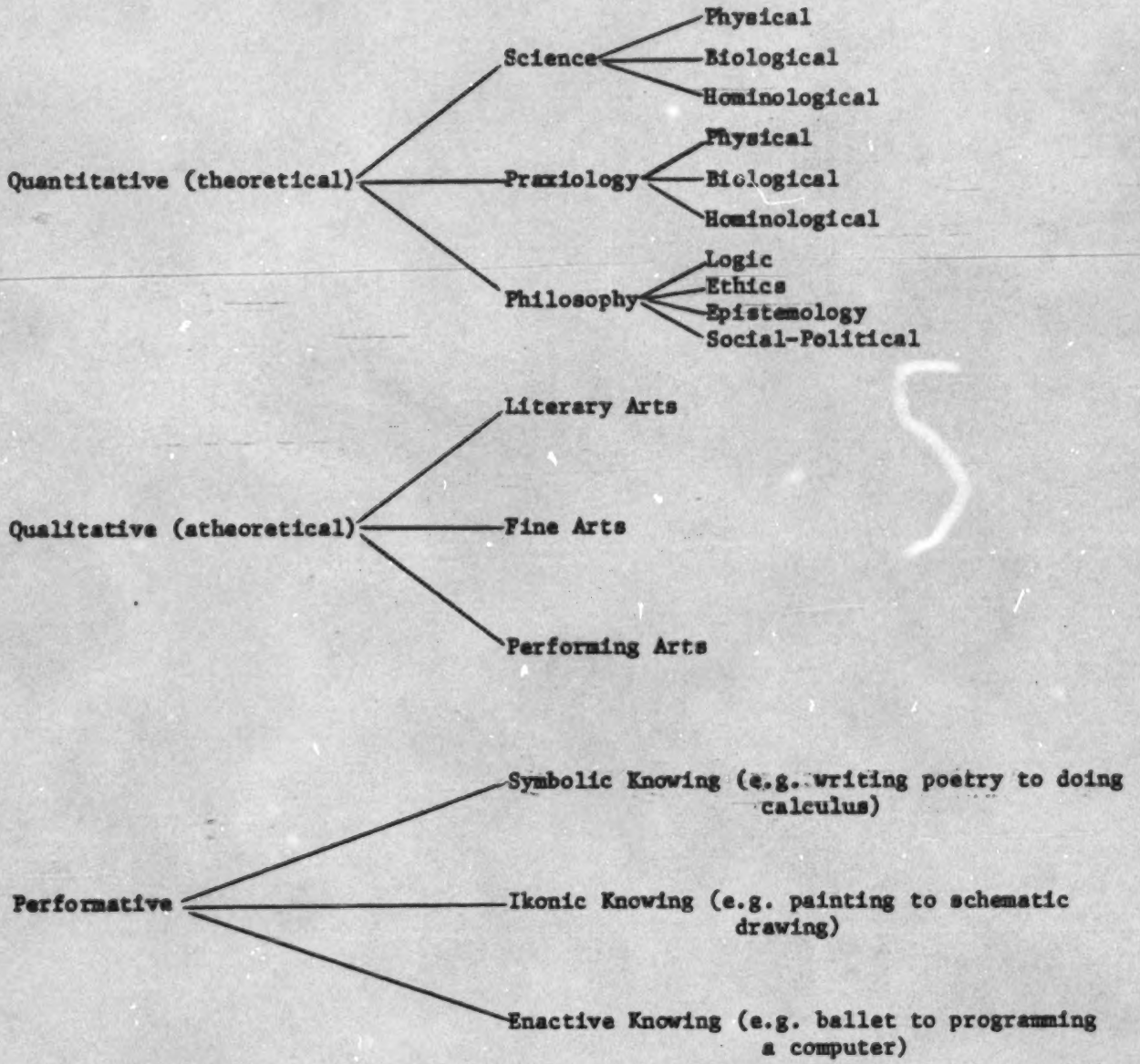
IKONIC PROPOSITIONS

Pictorial representations _____ Diagrammatic representations

ENACTIVE PROPOSITIONS

Fine performances _____ Mechanical performances

SCHEMA 1: Kinds of Assertions



SCHEMA 2: Kinds of Knowledge and Knowing

sorted as follows:

1. Science. In scientific theoretical knowledge, the content of the generalizations is empirical and non-normative (non-axiological). The generalizations do not describe what is valuable or good. In this sense science is value-free. However, science is not value-free insofar as the content of science is descriptive of what is taken to be valuable or good, or insofar as scientists qua scientists must hold certain values. Only as population tendencies do norms enter the content of science. The norms that govern the doing of science are not a part of the content but are a meta-theoretical matter (Maccia, 1975, p. 46).

The various scientific disciplines may be categorized as to whether they are physical, biological or hominological. The physical sciences have as their object of inquiry, matter and energy. Physics and chemistry are two of the physical sciences. Living things are the object of biological inquiry, e.g. Plant Anatomy and Embroyology. Hominological sciences are sciences which study the human. The behavioral sciences inquire into the nature of human beings, as well as the social sciences and anthropology.

2. Praxiology. Praxiological inquiry is a branch of theoretical knowledge which describes effective means-ends relationships. It is not merely applied science because the content of the generalizations, which are normative, are not deducible from scientific ones. Praxiology is concerned with instrumental norms since it is knowledge of practices. A practice is a system of human acts which may or may not include physical or non-human living objects as instruments in such acts (Maccia, 1975, p.46). Practices by their very nature are means-ends relationships, devised by humans to be effective for whatever they have in mind to accomplish.

Praxiological inquiry can be sorted on the basis of kind of end to be achieved. Physical praxiologies, such as civil engineering, have ends which are physical: roads, bridges, etc. Agriculture and other biological praxiologies have a biological end, i.e. the production of certain kinds of plants or animals. Human praxiologies, which include education, have human ends, i.e. a certain kind of human being (Maccia, 1975, p.47).

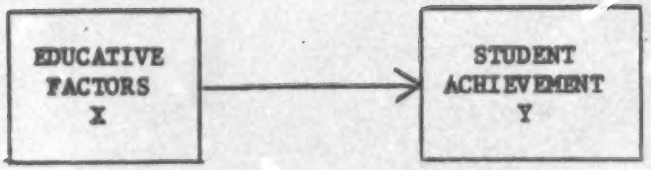
3. Philosophy. Philosophical inquiry is the other kind of theoretical knowledge descriptive of normative (axiological) matters. The content of philosophical generalization, however, is non-empirical and non-instrumental, i.e. the content is descriptive not of what is effective but of what is intrinsically worthwhile. Philosophical inquiries may generally be categorized as follows: ethics and social-political philosophy which are concerned with generalizations of ideal standards for individual and group human being; epistemology which describes ideal standards for human knowledge, knowing and belief; logic which describes ideal standards for discourse and method; metaphysics which describes ideal standards for being.

If 'curriculum' in teaching-learning systems is held to be that which is to be taught or to be learned, i.e. the accumulated knowledge and knowing (or 'culture' broadly characterized), clearly the optimal transmission of the accumulated knowledge and knowing from one generation to the succeeding one requires adequate organization of those curricular components constituting knowledge and knowing. Much educational curriculum organization has been governed by atomistic, mechanistic models. Thus the goal of educational systems has been interpreted as knowledge of curricular parts as the determinant of learner achievement. Human teaching-learning systems have been reduced to ones involving a limited number of curricular factors and the effects of these factors have been taken to be linear and additive. The educative effects models

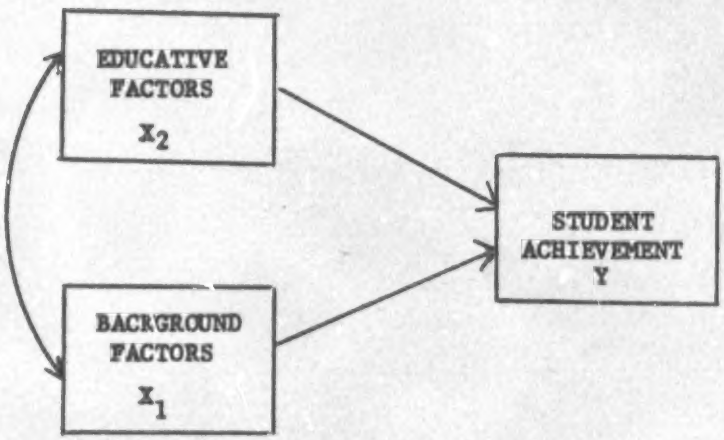
governing research into teaching-learning systems are also mechanistic and are either statistical or non-statistical depending upon whether the standpoint has been psychological or sociological (Maccia, 1976, p. 23). Both models are linear and additive constituting mechanistic approaches or points of view. (See schemas 3 and 4).

An organismic approach to curriculum organization would view the teaching-learning system as a structured whole, i.e. one in which the content and form of its parts are determined by its function. In such a system the curriculum components--the parts--do not have non-alterable natures and fixed actions (or relations). Rather, the parts would be related interdependently so as to maintain function, and therefore wholeness. The function is the production of multidisciplinary and interdisciplinary inquirers. To see how this is so, some clarity regarding the logical and epistemological relations obtaining (or possible to obtain) among disciplines which constitute the meanings of 'multidisciplinary' and 'interdisciplinary' is necessary.

The terms 'multidisciplinary' and 'interdisciplinary' have relatively specific meanings largely determined by the logical relations obtaining among kinds of truth-functional (knowledge-producing) inquiry, and by the specifications or definitions given to the phenomenon or phenomena constituting the object(s) of inquiry. Attention has been given to the meanings of these terms---primarily in the natural and biological sciences--because of the significant effect their meanings have on the direction and substance of truth-functional efforts in the various scientific disciplines. A concern for developing interdisciplinary methods of inquiry, for instance, is evident in general systems theory itself, i.e. general properties or principles common to diverse systems which provide methodological tools necessary for describing and explaining existing systems



SCHEMA 3: Psychological Educative Effects Model
(Maccia, 1976, p. 25)



SCHEMA 4: Sociological Educative Effects Model
(Maccia, 1976, p. 26)

as well as the logical possibilities for producing new ones. With respect to knowledge and knowing systems, i.e. curriculum components (where a given component is a subsystem of the larger total curriculum system), the significance of the logical relations with respect to interdisciplinary inquiry may be illustrated, for instance, by the development of biochemistry. That is, where sets of statements, S, were produced from the area of overlapping inquiry between the two domains of inquiry (disciplines), biology and chemistry, the question arose as to the epistemological disposition of statements S. A reductionist reply would attempt to state a rule according to which the statements falling in the area of overlap would always be reducible to one domain of inquiry or the other. One problem with this position (among others) is that the logical nature of truth-functional inquiry is such that there are no pure domains of inquiry—a position which seems implicit in the traditional academic groupings of subjects. There is a degree of overlap with other disciplines in all cases (though not overlap with all other disciplines). In addition, a reductionist position eliminates logical possibilities for producing new disciplines—e.g. in the above example it would eliminate the logical possibility (which has become empirical fact) of biochemistry.

The example of biochemistry was used to illustrate two points: first, the necessity for becoming clear on the logical relations obtaining between disciplines so as to exhibit not only existing relations but logical possibilities for new ones, hence becoming clear on models for curriculum organization and planning productive of multidisciplinary and interdisciplinary inquirers. Secondly, the example was used to illustrate an instance of interdisciplinary inquiry, not multidisciplinary. Though biochemistry is a discipline of chemistry, the questions biochemists ask were not (at one time) reducible to already existing categories of chemistry, hence a new category (discipline) was produced from

the area of overlap between biological states of affairs and chemistry states of affairs and methods. The basis for the claim that biochemistry is the result of interdisciplinary inquiry is that the method of inquiry and locus of the inquiry is drawn from the area of overlap between two empirical, non-normative disciplines—contained within one large category of knowledge, i.e. science. The inquiry is not multidisciplinary because the methods and locus of the inquiry are not drawn from more than one logical/epistemological category of theoretical knowledge, e.g. normative and empirical inquiry such as praxiology, or normative and non-empirical inquiry such as philosophy.

Inquiry which is multidisciplinary in scope may be demonstrated where the object of inquiry requires empirical and non-empirical as well as normative (both instrumental and intrinsic worthwhileness) and non-normative inquiry to attain sufficient understanding for whatever humans have in mind with respect to that object or state of affairs. That is, multidisciplinary inquiry requires more than one logical/epistemological kind of question to be asked about a given state of affairs. This kind of inquiry is also manifest in general systems theory and is encouraged as a means for counteracting investigations,

> directed by inertia into the same old channels well trodden by reliable science that produces practical results, where practical means translatable into technology without regard for the changed role of metatechnology in the world governed by a polluted semantic environment (Rapaport, 1976).

As Rapaport has made clear (1976), philosophical questions have been revitalized by general systems theory which has revived organismic thinking as a complement to analytic thinking. The necessity for multidisciplinary inquiry into such state of affairs as the environment, for instance, has been made abundantly clear in general systems theory. The organismic point of view emphasizes the interdependence of life on this planet and a rejection of non-alterable natures and

fixed actions of technology---because of the long-range effects such technology has on the survival of life.

Education, the teaching-learning process, is also such a state of affairs requiring multidisciplinary inquiry. As the teaching-learning process is a process devised by humans to accomplish certain ends, i.e. the transmission of the accumulated culture (knowledge, knowing, wisdom--i.e. that which not only maintains but increases our civilized status), it should be clear that inquiry into education in a single logical/epistemological category, e.g. the sciences, will not provide sufficient understanding, including direction and control over the process, to permit the accomplishment of that end. The long-range effects of educative processes necessitate an organismic view of the interdependencies of the components of those processes, e.g. curriculum components, and a rejection of the technical "fixes" which have come to influence the teaching-learning process as well as inquiry into that process. Not only is it the case, however, that educators are taught teaching <u>methods</u> which are mechanistic, they are also taught to view inquiry into the process according to the mechanistic educative effects models as depicted in schemas 3 and 4.

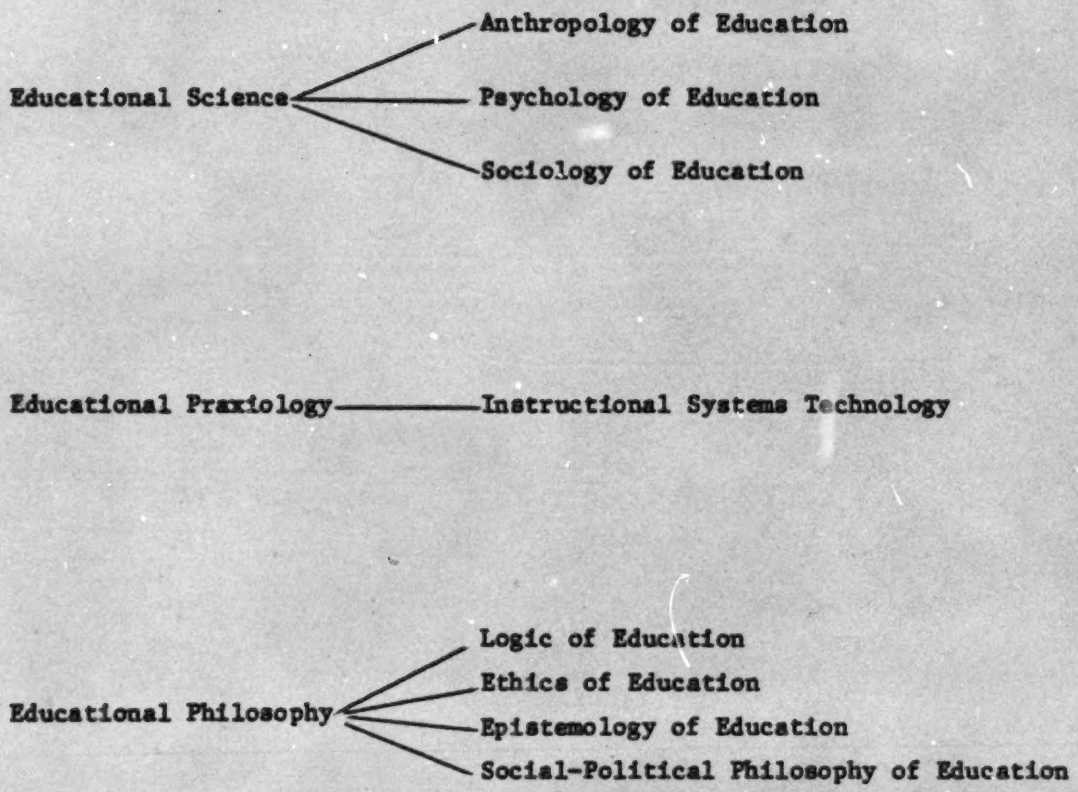
As educators must be equipped with a knowledge base to permit diagnosis, i.e. explaining why a state of affairs is what it is, prognosis, i.e. predicting what future state of affairs will be, and design, i.e. developing states of affairs, that knowledge base must be multidisciplinary in design. The multidisciplinary nature of such inquiry permits an organismic view of educational systems. With such an organismic view of the teaching-learning process, including the organismic design of curriculum components, the function of cultivating multidisciplinary and interdisciplinary inquirers would be effected.

A multidisciplinary view of curriculum components in the education of educators would allow the following delineation of kinds of theoretical knowledge to be

produced about teaching-learning processes: Educational Science, which inquires into educational human behavior, is a hominological science. The aim of educational hominological science would be to inquire into education so as to adequately characterize the general properties of teachers, learners, curricula, and settings and the relations between these properties. Such educational hominological sciences as psychology of education and sociology of education have emerged. Educational Praxiology has as its end the production of a certain kind of human being and attempts to devise effective means to achieve that end. An educational praxiologist inquires into education so as to characterize instrumental axiological properties of educational practices. In addition, insofar as there is a concern in educational systems and inquiry into educational systems for ideal individual and group human being, for ideal discourse and method, for ideal human knowledge, knowing and belief--at least these kinds of Educational Philosophy can be distinguished: ethical, social-political, logical and epistemological. These logical/epistemological kinds of theoretical knowledge about education are depicted in schema 5.

Moreover, both educational qualitative (atheoretical) knowing and educational performative knowledge and knowing would have to be explicated, particularly as they overlap with the categories of theoretical knowledge set forth above. An instance of atheoretical knowing might be the felt quality of hostility to the depersonalized correctional educational institution as exhibited by the long-distance runner in Sillitoe's (1970) The Lonliness of the Long-Distance Runner. An instance of educational performative knowing might be a teacher's knowing how to reduce such hostility in a learner, as exhibited enactively in the teacher-learner interactions.

The categories of theoretical knowledge were utilized for illustrative purposes only, i.e. to illustrate the multidisciplinary possibilities (and some realities) for knowledge production about a given state of affairs, the teaching-learning process. The interrelations obtaining or possible to obtain among the categories

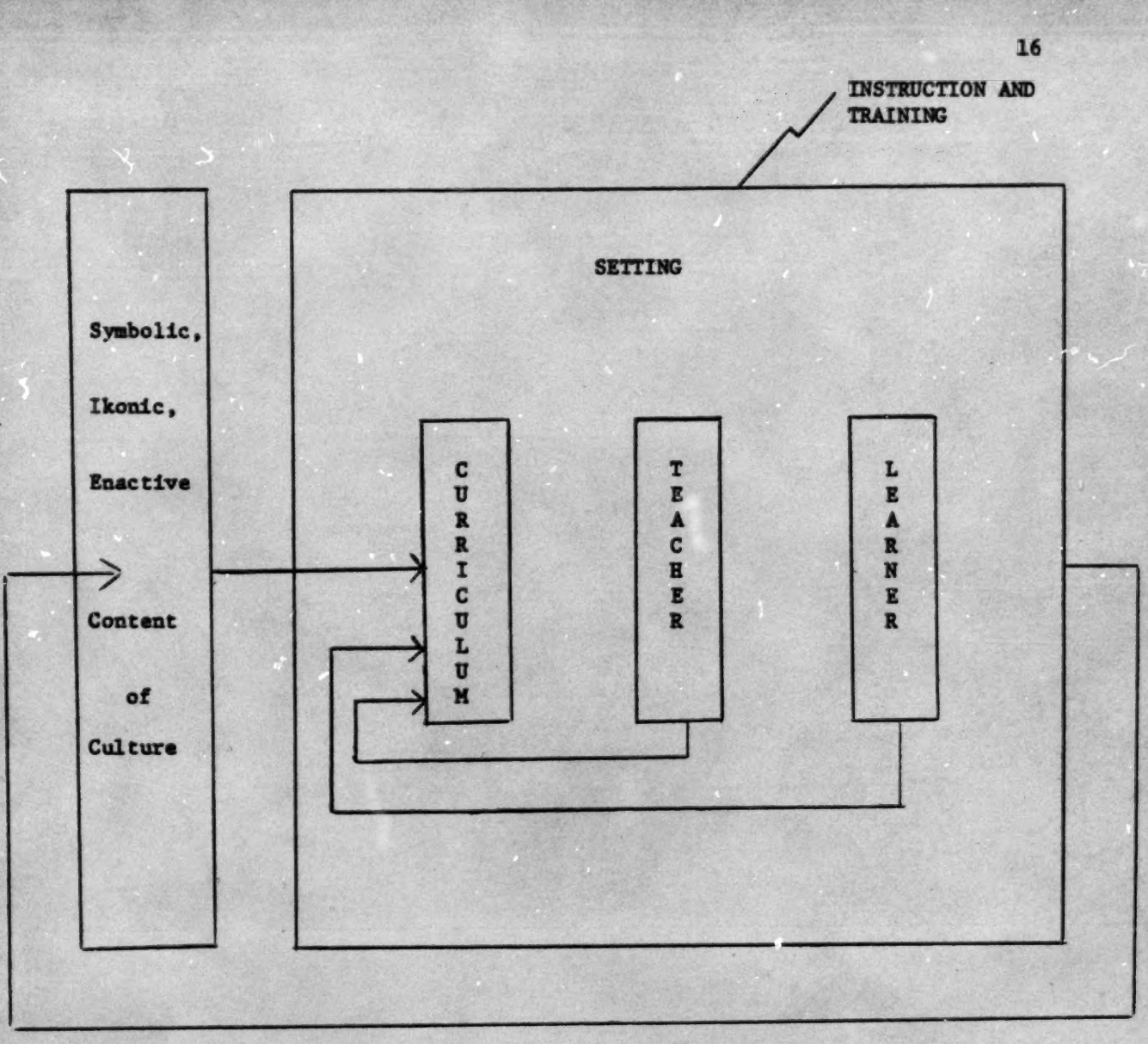


SCHEMA 5: Kinds of Theoretical Knowledge about Education

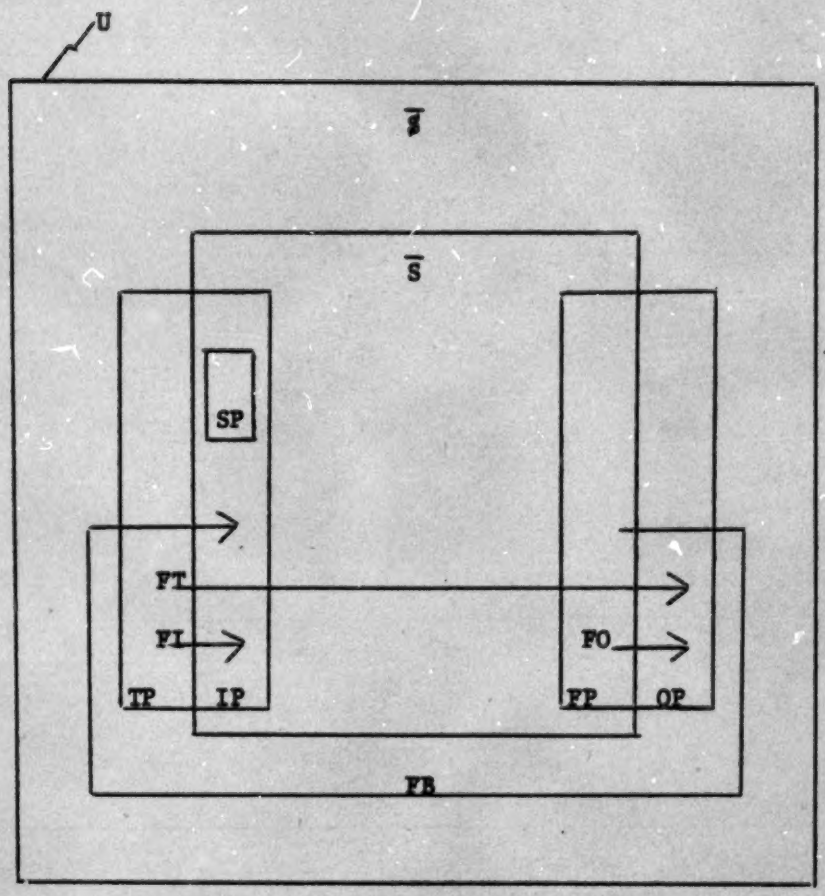
have not been illustrated, though hopefully some may be seen. There has been overlapping inquiry between psychology of education (empirical, non-normative) and ethics of education (non-empirical, normative—the norm of intrinsic worthwhileness), e.g. Kohlberg's (1973) inquiry into the moral development of children. In addition, the categories of atheoretical knowing and performative knowledge and knowing have not been elaborated upon to illustrate even more poignantly the multidisciplinary nature of inquiry into education as well as the multidisciplinary nature of the teaching-learning process itself.

Inquiry into educational states of affairs which involves organismic theory models would have as its goal generalizations describing and explaining the dynamics of human cultivation configurations, i.e. the production of multidisciplinary and interdisciplinary inquirers. These configurations would be represented as teaching-learning systems constituted by the subsystems: teacher, learner, curriculum, setting. An adequate organismic theory model which describes and explains the dynamics of the cultivation relative to curriculum components would include descriptions of education-surroundings interactions. That is, the organismic model would permit the determination of what education takes in (the symbolic, ikonic, enactive propositional components) and what is available from it and also a determination of what education's surroundings take in and what is available to them. Transmission from and to both the system and its surroundings would be characterized. This is depicted in schemas 6 and 7.

As an illustration, utilizing the SIGGS organismic theory model as depicted in schema 7, the flow of knowledge and knowing from teacher to learner would be represented through the concept of feedin, i.e. shared information. 'Culture' is interpreted as selective information, i.e. as probable occurrences in categories of societal expressions (Maccia, 1976, p. 30). Measure of the



SCHEMA 6: Organismic View of Curriculum
As a Component of Instruction and Training



'U' stands for universe of discourse
'S̄' stands for system
'S̄̄' stands for negasystem
'SP' stands for storeputness
'FT' stands for feedthroughness
'FI' stands for feedinness
'TP' stands for toputness
'IP' stands for inputness
'FO' stands for feedoutness
'FP' stands for fromputness
'OP' stands for outputness
'FB' stands for feedbackness

SCHEMA 7: SIGGS Educational Theory Model
(Maccia, 1976, p. 29)

commonality between toput and input can be obtained by H measures on the knowledge and knowing of the teacher that is available to the learner and on the knowledge and knowing taken in by the learner. Commonality is indicative of decreased uncertainty, i.e. learning.

In conclusion, the organismic model of curriculum components representing multidisciplinary and interdisciplinary inquiry in the context of the larger organismic model of teaching-learning systems, would effect the production of multidisciplinary and interdisciplinary inquirers. The necessity for educational systems to focus attention on the logical/epistemological relations obtaining or possible to obtain among kinds of inquiry has been argued for so as to provide an organismic systemic curriculum model productive of multidisciplinary and interdisciplinary inquirers.

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